Dermatosurgery Specials

Standard guidelines of care: Keloids and hypertrophic scars

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ABSTRACT

Keloids and hypertrophic scars (HTS) are the result of overgrowth of fibrous tissue, following healing of a cutaneous injury, and cause morbidity. There are several treatment modalities which are useful for the management of keloids, though no single modality is completely effective. The most commonly used modalities are pressure, silicone gel sheet, intralesional steroids, 5-fluorouracil (5 FU), cryotherapy, surgical excision, and lasers. They may be used either singly or, as is done more commonly, in combinations. Any qualified dermatologist who has attained postgraduate qualification in dermatology can treat keloids and HTS. Some procedures, such as cryosurgery and surgical excision, may require additional training in dermatologic surgery. Most modalities for keloids, including intralesional injections and mechanical therapies such as pressure and silicone gel based products, can be given/prescribed on OPD basis. Surgical excision requires a minor operation theater with the facility to handle emergencies. It is important to counsel the patient about the nature of the problem. One should realize that keloid will only improve and not disappear completely. Patients should be informed about the high recurrence rates. Different modalities carry risk of adverse effects and complications and the treating physician needs to be aware of these and patients should be informed about them.

Key words: Hypertrophic scars, keloids, steroids, cryosurgery

INTRODUCTION

Keloids and hypertrophic scars (HTS) are the result of an overgrowth of fibrous tissue following healing of a cutaneous injury. Keloids extend beyond the margins of the original wound, do not usually regress spontaneously, and tend to recur after excision, while HTS do not expand beyond the boundaries of the initial injury and may undergo partial spontaneous resolution.

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RATIONALE AND SCOPE

No single treatment is uniformly effective in all patients and multiple treatment options may be needed in a patient. These guidelines review current evidence for the efficacy of each treatment modality and provide basic recommendations based on them, so that the physician can choose the treatment modality appropriate for an individual patient while taking efficacy, adverse effects, therapeutic and cosmetic outcome, feasibility, patient's preference, and cost into consideration.

PHYSICIAN'S QUALIFICATION AND FACILITY

Physicians involved in the management of keloids and HTS should have a postgraduate qualification in dermatology or super-specialization in plastic surgery. The management of keloids and HTS is challenging

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and often requires additional clinical skills such as specialized training in dermatologic surgery. Radiotherapy needs to be delivered by a specialist.

Some of the procedures, such as intralesional injections or surface cryosurgery, can be done in the physician's treatment room. More invasive modalities like surgical excision require more specialized care such as a minor OT with a trained nurse as an assistant. The minor OT should have a tray with emergency medications, oxygen cylinder and intravenous catheter. An anesthetist should be ready on call.

COUNSELING

Patients should be informed in detail about the nature and course of the disease, available treatment options suitable to an individual patient, their efficacy and adverse effects, and cost. They should be informed about the possibility of recurrences after treatment. The final decision to undertake treatment should lie with the patients. Informed consent should be obtained in all cases. Pretreatment photography is recommended.

DIFFERENT MODALITIES AND THEIR CURRENT STATUS IN THE MANAGEMENT OF KELOIDS

It is important to note that it is difficult to eradicate keloids and most of the modalities are associated with some adverse effects. While these modalities have evidence of variable degree, there are problems in finding and categorizing evidence from the literature, as most studies suffer from subjective evaluation of treatment outcome, limited or no follow-up, and poor study design. Many studies have not differentiated HTS from keloid, which responds more readily to simpler treatments.[1-4] This review excludes such studies. Furthermore, keloids at different sites respond differently; for example, earlobe keloid recurs less often after surgical excision while pre-sternal keloids almost invariably recur after surgical excision alone. All these factors make it difficult to compare the results of different studies.

The primary goals while planning a treatment protocol should be a low recurrence rate, significant cosmetic and symptomatic improvement and minimal adverse effects. In the guidelines, we have included treatment modalities with at least two published studies/case series that include one good quality study.

1. **Intralesional corticosteroids:** This is the most frequently used modality, the steroid most commonly used, being depot preparation of triamcinolone acetonide. The concentration of triamcinolone acetonide depends upon the size and site of the lesion and age of the individual. Generally, it is used in a concentration of 10–20 mg/ml, though it can be given at a dose of 40 mg/ml for a tough bulky lesion. It is important to inject the steroid at a correct depth in mid-dermis, otherwise it may lead to irreversible atrophy of the epidermis. Injections are repeated once in 3–4 weeks depending on the bulk of keloid and therapeutic response. The total number of injections depends on the response and possible side effects. Pain during injection is an important limiting factor. Triamcinolone injection alone is effective in reducing the volume of lesions in a majority of patients (LEVEL A).[1] Ardehali *et al*.[2] reported that mean scar volume reduced from 0.73 ± 0.701 ml at baseline to 0.14 ± 0.302 ml after monthly intralesional injections of triamcinolone acetate (LEVEL A). Combination 5-fluorouracil (5-FU)/triamcinolone seems to be superior to intralesional steroid therapy alone in the treatment of keloids (92% average reduction in lesion size with combination compared with 73% with steroid alone).[3] Postoperative intralesional triamcinolone after surgical excision seems to prevent recurrence (LEVEL B). With these evidences available, intralesional steroids should be considered as the first line treatment for keloids and hypertrophic scars.[4]

REFERENCES

1. Muneuchi G, Suzuki S, Onodera M, Ito O, Hata Y, Igawa HH. Long-term outcome of intralesional injection of triamcinolone acetonide for the treatment of keloid scars in Asian patients. Scand J Plast Reconstr Surg Hand Surg 2006;40:111-6 (LEVEL B).
2. Ardehali B, Nouraei SA, van Dam H, Dex E, Wood S, Nduka C. Objective assessment of keloid scars with three-dimensional imaging: Quantifying response to intralesional steroid therapy. Plast Reconstr Surg 2007;119:556-61 (LEVEL A).
3. Davison SP, Dayan JH, Clemens MW, Sonni S, Wang A, Crane A. Efficacy of intralesional 5-fluorouracil and triamcinolone in the treatment of keloids. Aesthet Surg J 2009;29:40-6 (LEVEL C).
4. Chowdri NA, Masarat M, Mattoo A, Darzi MA. Keloids and hypertrophic scars: Results with intraoperative and serial postoperative corticosteroid injection therapy. Aust N Z J Surg 1999;69:655-9 (LEVEL B).

2. **5-Fluorouracil (5-FU) intralesional injections:** This treatment is increasingly becoming popular. 5-FU alone is effective in the treatment of keloids

(LEVEL B).[1,2] Haurani and colleagues[3] combined it with surgical excision of keloids which failed to respond to intralesional triamcinolone alone; only 19% of them recurred after 1 year of follow-up. Therefore, a recommendation is made that intralesional 5-FU can be combined with surgical excision of keloids, as it prevents recurrence after excision in a majority of patients.[3] Similarly, there is enough evidence that a combination of 5-FU and triamcinolone is superior over triamcinolone alone (15% vs. 40%, LEVEL B).[4,5] There is also evidence that a combination of triamcinolone and 5-FU results in less skin atrophy and telangiectasia than triamcinolone alone (LEVEL C).[6] Pain, hyperpigmentation, and tissue sloughing are the main adverse effects of 5-FU therapy for keloids (LEVEL B).[7]

In summary, intralesional injection of 5-FU is considered as a safe and effective treatment, when used either alone or in combination with intralesional injection of corticosteroids and surgical excision.

REFERENCES

1. Gupta S, Kalra A. Efficacy and safety of intralesional 5-fluorouracil in the treatment of keloids. Dermatology 2002;204:130-2 (LEVEL B).
2. Nanda S, Reddy BS. Intralesional 5-fluorouracil as a treatment modality of keloids. Dermatol Surg 2004;30:54-6 (LEVEL B).
3. Haurani MJ, Foreman K, Yang JJ, Siddiqui A. 5-Fluorouracil treatment of problematic scars. Plast Reconstr Surg 2009;123:139-48 (LEVEL B).
4. Darougheh A, Asilian A, Shariati F. Intralesional triamcinolone alone or in combination with 5-fluorouracil for the treatment of keloid and hypertrophic scars. Clin Exp Dermatol 2009;34:219-23 (LEVEL B).
5. Davison SP, Dayan JH, Clemens MW, Sonni S, Wang A, Crane A. Efficacy of intralesional 5-fluorouracil and triamcinolone in the treatment of keloids. Aesthet Surg J 2009;29:40-6 (LEVEL B).
6. Manuskiatti W, Fitzpatrick RE. Treatment response of keloidal and hypertrophic sternotomy scars: Comparison among intralesional corticosteroid, 5-fluorouracil, and 585-nm flashlamp-pumped pulsed-dye laser treatments. Arch Dermatol 2002;138:1149-55 (LEVEL C).
7. Kontochristopoulos G, Stefanaki C, Panagiotopoulos A, Stefanaki K, Argyrakos T, Petridis A, *et al*. Intralesional 5-fluorouracil in the treatment of keloids: An open clinical and histopathologic study. J Am Acad Dermatol 2005;52:474-9 (LEVEL B).

3. **Bleomycin:** Intralesional injection of Bleomycin appears to be an effective therapy in the treatment of keloids, with almost three-fourth of the patients showing good to excellent results (LEVEL B). It is administered either by intralesional injections or by multiple punctures using 22-G needle.[1-4] The reported adverse events include hyperpigmentation in a small proportion of patients (LEVEL B).[5] However, it is more expensive as compared to steroids and 5-FU and this may be a limiting factor.

REFERENCES

1. Bodokh I, Brun P. Treatment of keloid with intralesional bleomycin. Ann Dermatol Venereol 1996;123:791-4 (LEVEL B).
2. España A, Solano T, Quintanilla E. Bleomycin in the treatment of keloids and hypertrophic scars by multiple needle punctures. Dermatol Surg 2001;27:23-7 (LEVEL B).
3. Naeini FF, Najafian J, Ahmadpour K. Bleomycin tattooing as a promising therapeutic modality in large keloids and hypertrophic scars. Dermatol Surg 2006;32:1023-9 (LEVEL B).
4. Aggarwal H, Saxena A, Lubana PS, Mathur RK, Jain DK. Treatment of keloids and hypertrophic scars using bleom. J Cosmet Dermatol 2008;7:43-9 (LEVEL B).
5. Saray Y, Güleç AT. Treatment of keloids and hypertrophic scars with dermojet injections of bleomycin: A preliminary study. Int J Dermatol 2005;44:777-84 (LEVEL B).

4. **Interferon α-2b:** Intralesional injection of combination of interferon α-2b with triamcinolone has been reported to be superior to triamcinolone alone in reducing the depth and volume of keloids (LEVEL C).[1] However, contradictory results have also been reported.[2] Current evidence is therefore not unequivocal to recommend the routine use of interferon α-2b. It may be used in selected cases, particularly when the more established intralesional injection modalities described above have failed.

REFERENCES

1. Lee JH, Kim SE, Lee AY. Effects of interferon-alpha2b on keloid treatment with triamcinolone acetonide intralesional injection. Int J Dermatol 2008;47:183-6 (LEVEL C).
2. Davison SP, Mess S, Kauffman LC, Al-Attar A. Ineffective treatment of keloids with interferon alpha-2b. Plast Reconstr Surg 2006;117:247-52 (LEVEL C).

5. **Verapamil:** Experimentally, it has been shown to stimulate the synthesis of procollagenase, thus increasing collagenase activity, thereby leading to a reduction in fibrous tissue production. However, there has been limited clinical data showing its efficacy in keloids (LEVEL C). Thus, more studies are needed before it is recommended as a routine treatment for keloids.[1,2]

REFERENCES

1. D'Andrea F, Brongo S, Ferraro G, Baroni A. Prevention and treatment of keloids with intralesional verapamil. Dermatology 2002;204:60-2 (LEVEL C).
2. Xu SJ, Teng JY, Xie J, Shen MQ, Chen DM. Comparison of the

mechanisms of intralesional steroid, interferon or verapamil injection in the treatment of proliferative scars. Zhonghua Zheng Xing Wai Ke Za Zhi 2009;25:37-40 (LEVEL C).

6. **Imiquimod:** Imiquimod 5% cream is a novel immune modulator with localized therapeutic effects at the drug application site, capable of enhancing local production of immune-stimulating cytokines such as interferons, tumor necrosis factor, and interleukins. In a few studies,[1-3] imiquimod cream has been used in conjunction with surgical excision, with an objective of preventing recurrence after surgical excision. However, the antifibrotic effect seems to be short-lived and lesions recur after discontinuation of keloids. There are conflicting data about its efficacy. The evidence is thus not adequate to establish the efficacy and the role of imiquimod in the prevention of recurrence of keloids after surgical excision (LEVEL B).[1-3]

REFERENCES

1. Malhotra AK, Gupta S, Khaitan BK, Sharma VK. Imiquimod 5% cream for the prevention of recurrence after excision of presternal keloids. Dermatology 2007;215:63-5 (LEVEL B).
2. Martin-García RF, Busquets AC. Postsurgical use of imiquimod 5% cream in the prevention of earlobe keloid recurrences: Results of an open-label, pilot study. Dermatol Surg 2005;31:1394-8 (LEVEL B).
3. Cação FM, Tanaka V, Messina MC. Failure of imiquimod 5% cream to prevent recurrence of surgically excised trunk keloids. Dermatol Surg 2009;35:629-33 (LEVEL B).

7. **Pressure therapy:** Though it is a popular treatment modality for keloids and HTS, there is no proven mechanism of its action in keloid treatment. The expert recommendation is to apply 20–40 mm Hg pressure for 24 hours a day. While several studies have documented its efficacy, other studies reported no difference in the results after pressure therapy. Pressure therapy alone is considered effective for prevention of hypertrophic burn scars (LEVEL C). Pressure may alleviate itching and pain and may cause early scar maturation (LEVEL C).[1,2] Pressure loss, discomfort from heat and sweating, swelling of limbs, rashes, eczema, friction, and poor compliance are the problems associated with pressure therapy (LEVEL B).[3]

REFERENCES

1. Leung P, Ng M. Pressure treatment for hypertrophic scars resulting from burns. Burns 1980;6:244 (LEVEL C).
2. Haq MA, Haq A. Pressure therapy in treatment of hypertrophic scar, burn contracture and keloid: The Kenyan experience. East Afr Med J 1990;67:785-93 (LEVEL B).
3. Cheng JC, Evans JH, Leung KS, Clark JA, Choy TT, Leung PC. Pressure therapy in the treatment of postburn hypertrophic scars: A critical look into its usefulness and fallacies by pressure monitoring. Burns Incl Therm Inj 1984;10:154-63 (LEVEL B).

8. **Silicone products**: Silicone is available as cream, gel sheet, silastic sheet, and orthosis garment. The mechanism of action of silicone therapy has not been completely determined, but is likely to involve occlusion and hydration of the stratum corneum with subsequent cytokine-mediated signaling from keratinocytes to dermal fibroblasts (LEVEL C).[1] The sheet may result in flattening of lesion, increased malleability and softening of the scar, though one study showed that there was no difference in the results with silicone and non-silicone gel sheet dressing (LEVEL C).[2] Vitamin E added to silicone gel has been reported to be beneficial in one study, though not enough evidence is available for its efficacy (LEVEL C).[3] Silicone products have the advantages of ease of administration and being noninvasive, without side effects. Further, their use is supported by some published studies.[4] However, the data available are of poor quality and additional controlled clinical trials with large patient populations are needed to generate further evidence for the efficacy of silicone based products in the treatment and prevention of hypertrophic and keloid scars (LEVEL B).[5,6]

REFERENCES

1. Mustoe TA. Evolution of silicone therapy and mechanism of action in scar management. Aesthetic Plast Surg 2008;32:82-92 (LEVEL C).
2. de Oliveira GV, Nunes TA, Magna LA, Cintra ML, Kitten GT, Zarpellon S, *et al*. Silicone versus nonsilicone gel dressings: A controlled trial. Dermatol Surg 2001;27:721-6 (LEVEL C).
3. Palmieri B, Gozzi G, Palmieri G. Vitamin E added silicone gel sheets for treatment of hypertrophic scars and keloids. Int J Dermatol 1995;34:506-9 (LEVEL C).
4. Eishi K, Bae SJ, Ogawa F, Hamasaki Y, Shimizu K, Katayama I. Silicone gel sheets relieve pain and pruritus with clinical improvement of keloid: Possible target of mast cells. J Dermatolog Treat 2003;14:248-52 (LEVEL C).
5. Berman B, Perez OA, Konda S, Kohut BE, Viera MH, Delgado S, *et al*. A review of the biologic effects, clinical efficacy, and safety of silicone elastomer sheeting for hypertrophic and keloid scar treatment and management. Dermatol Surg 2007;33:1291-302.
6. O'Brien L, Pandit A. Silicon gel sheeting for preventing and treating hypertrophic and keloid scars. Cochrane Database Syst Rev 2006;1:CD003826 (LEVEL A).

9. **Onion extract**: The topical preparation containing onion extract and allantoin is being marketed and frequently used for keloids and HTS. However,

there is only limited evidence of its efficacy (LEVEL C).[1] In a study by Hosnuter *et al*., it was found to be ineffective in improving scar height and itching[2] (LEVEL C).

REFERENCES

1. Koc E, Arca E, Surucu B, Kurumlu Z. An open, randomized, controlled, comparative study of the combined effect of intralesional triamcinolone acetonide and onion extract gel and intralesional triamcinolone acetonide alone in the treatment of hypertrophic scars and keloids. Dermatol Surg 2008;34:1507-14 (LEVEL C).
2. Hosnuter M, Payasli C, Isikdemir A, Tekerekoglu B. The effects of onion extract on hypertrophic and keloid scars. J Wound Care 2007;16:251-4 (LEVEL C).

10. Radiotherapy: Radiotherapy has been used as a monotherapy or as an adjuvant to surgical excision. A combination of surgery followed 24 hours later by radiotherapy is thought to be the most effective approach for the management of extensive HTS and keloids which causes significant morbidity/limitation of movement/ contracture, with a recurrence rate varying from 9 to 72% (LEVEL B), which generally depends on the total dose of radiation and duration of follow-up.[1-4] A relatively high dose must be applied in a short overall treatment time[5] (LEVEL B). A scheme with a Biologically Effective Dose of 30–40 Gy seems to be sufficient to prevent recurrences of keloid after surgical excision (LEVEL B).[6] Electron beam irradiation is considered the most effective; however, strontium 90 brachytherapy has also shown low recurrence rate (LEVEL C).[7] Recently, 32p-patch contact brachyradiotherapy has been introduced for keloids and found to be effective (LEVEL C).[8] Radiation is associated with the risk of carcinogenesis, and there is hesitation and apprehension about its use for a benign condition such as keloids. However, there are only few reports in the literature of malignancies arising from the treatment of keloid scars with radiotherapy.[9-12] Other adverse reactions include skin redness, skin peeling, telangiectasia and permanent skin color changes, generally hypopigmentation (LEVEL B).[11]

In summary, while there are a large number of studies available in recent literature on the use of radiation therapy in keloids, its current use in routine practice is limited both because of the nonavailability of the modality in most centers and also a general apprehension about its use. However, it may be an effective option for recalcitrant and large keloids not responding to other treatments in centers where facilities are available, particularly, in combination with surgical excision.

REFERENCES

1. Ragoowansi R, Cornes PG, Moss AL, Glees JP. Treatment of keloids by surgical excision and immediate post-operative single-fraction radiotherapy. Plast Reconstr Surg 2003;111:1853-9 (LEVEL B).
2. Subedi N, Roberts F. Radiotherapy treatment of keloid scars and other benign conditions: Is there a need for a database of patients treated? Br J Dermatol 2009;161:194-5 (LEVEL B).
3. Ogawa R, Miyashita T, Hyakusoku H, Akaishi S, Kuribayashi S, Tateno A. Postoperative radiation protocol for keloids and hypertrophic scars: Statistical analysis of 370 sites followed for over 18 months. Ann Plast Surg 2007;59:688-91 (LEVEL B).
4. Veen RE, Kal HB. Postoperative high-dose-rate brachytherapy in the prevention of keloids. Int J Radiat Oncol Biol Phys 2007;69:1205-8 (LEVEL B).
5. Kal HB, Veen RE. Biologically effective doses of postoperative radiotherapy in the prevention of keloids. Dose-effect relationship. Strahlenther Onkol 2005;181:717-23 (LEVEL B).
6. Kal HB, Veen RE, Jürgenliemk-Schulz IM. Dose-effect relationships for recurrence of keloid and pterygium after surgery and radiotherapy. Int J Radiat Oncol Biol Phys 2009;74:245-51 (LEVEL B).
7. Viani GA, Stefano EJ, Afonso SL, De Fendi LI. Postoperative strontium-90 brachytherapy in the prevention of keloids: Results and prognostic factors. Int J Radiat Oncol Biol Phys 2009;73:1510-6 (LEVEL C).
8. Vivante H, Salgueiro MJ, Ughetti R, Nicolini J, Zubillaga M. 32p-patch contact brachyradiotherapy in the management of recalcitrant keloids and hypertrophic scars. Indian J Dermatol Venereol Leprol 2007;73:336-9 (LEVEL C).
9. Botwood N, Lewinski C, Lowdell C. The risks of treating keloids with radiotherapy. Br J Radiol 1999;72:1222-4 (LEVEL B).
10. Bilbey JH, Muller NL, Miller RR, Nelems B. Localised fibrous mesothelioma of pleura following external ionizing radiation therapy. Chest 1988;94:1291-2 (LEVEL B).
11. Speranza G, Sultanem K, Muanza T. Descriptive study of patients receiving excision and radiotherapy for keloids. Int J Radiat Oncol Biol Phys 2008;71:1465-9 (LEVEL B).
12. Bischof M, Krempien R, Debus J, Treiber M. Postoperative electron beam radiotherapy for keloids: Objective findings and patient satisfaction in self-assessment. Int J Dermatol 2007;46:971-5 (LEVEL B).

11. Lasers: Carbon dioxide laser monotherapy has a recurrence rate as high as 90% and is therefore not recommended (LEVEL B).[1,2] Pulsed Dye Laser (PDL) has been reported to decrease transforming growth factor-beta1 (TGF-beta1) induction and up-regulation of matrix metalloproteinase (MMP) expression in keloid tissue (LEVEL C).[3,4] This may be responsible for the keloid regression with PDL treatment. PDL seems to regress majority of keloids (LEVEL C); however, a case of rapid recurrence has also been reported (LEVEL C).[5,6]

REFERENCES

1. Norris JE. The effect of carbon dioxide laser surgery on the recurrence of keloids. Plast Reconstr Surg 1991;87:44-9 (LEVEL B).
2. Apfelberg DB, Maser MR, White DN, Lash H. Failure of carbon dioxide laser excision of keloids. Lasers Surg Med 1989;9:382-8 (LEVEL B).
3. Kuo YR, Wu WS, Jeng SF, Wang FS, Huang HC, Lin CZ, *et al*. Suppressed TGF-beta1 expression is correlated with up-regulation of matrix metalloproteinase-13 in keloid regression after flashlamp pulsed-dye laser treatment. Lasers Surg Med 2005;36:38-42 (LEVEL C).
4. Kuo YR, Wu WS, Jeng SF, Nicolini J, Zubillaga M. Activation of ERK and p38 kinase mediated keloid fibroblast apoptosis after flashlamp pulsed-dye laser treatment. Lasers Surg Med 2005;36:31-7 (LEVEL C).
5. Kuo YR, Jeng SF, Wang FS, Chen TH, Huang HC, Chang PR, *et al*. Flashlamp pulsed dye laser (PDL) suppression of keloid proliferation through down-regulation of TGF-beta1 expression and extracellular matrix expression. Lasers Surg Med 2004;34:104-8 (LEVEL C).
6. Shih PY, Chen HH, Chen CH, Hong HS, Yang CH. Rapid recurrence of keloid after pulse dye laser treatment. Dermatol Surg 2008;34:1124-7 (LEVEL C).

12. Surgical excision: Surgical excision alone is associated with recurrence in 50–100% of patients; however, an exception is earlobe keloid which recurs much less frequently (LEVEL B).[1] Thus, after excision of keloid, an adjuvant should always be used (LEVEL A). Radiation, intralesional steroid and 5-FU prevent recurrence more efficiently than topical imiquimod and interferons (LEVEL B). Topical mitomycin, an antimetabolite, made no difference in the prevention of keloid recurrence after excision when topically applied (LEVEL C).[2] The keloid core extirpation and subtotal keloid excision may be helpful in preventing keloid recurrence; however, the evidence is limited (LEVEL C).[3,4] Postoperative pressure therapy designed to suit the individual patient needs is important to prevent the recurrences.

REFERENCES

1. Kim DY, Kim ES, Eo SR, Kim KS, Lee SY, Cho BH. A surgical approach for earlobe keloid: Keloid fillet flap. Arch Facial Plast Surg 2005;7:172-5 (LEVEL B).
2. Sanders KW, Gage-White L, Stucker FJ. Topical mitomycin C in the prevention of keloid scar recurrence. Arch Facial Plast Surg 2005;7:172-5 (LEVEL C).
3. Lee Y, Minn KW, Baek RM, Hong JJ. A new surgical treatment of keloid: Keloid core excision. Ann Plast Surg 2001;46:135-40 (LEVEL C).
4. Field LM. Subtotal keloid excision--a preferable preventative regarding recurrence. Dermatol Surg 2001;27:323-4 (LEVEL C).

13. Cryosurgery: Cryosurgery with liquid nitrogen leads to total or partial success in almost two-third to three-fourth of keloids after at least three sessions (LEVEL B).[1-3] Hypopigmentation, blistering, delayed healing and infection are the major side effects (LEVEL A).[4] A combination of liquid nitrogen cryosurgery and intralesional steroids seems to have a synergistic effect over liquid nitrogen cryosurgery alone (LEVEL B).[5] Liquid nitrogen cryotherapy done prior to the intralesional injection softens the keloid and makes the injection more easier and leads to uniform dispersal of the drug into pathological tissue. Cryotherapy induces edema and cellular breakdown, causing a decrease in the density of fibrous tissue so that the injection can be given easily. Intralesional cryosurgery seems to provide better esthetic results and cause less hypopigmentation in comparison to surface cryosurgery; however, no comparative studies are available, only case series are available (LEVEL C).[6-9]

REFERENCES

1. Zouboulis CC, Blume U, Büttner P, Orfanos CE. Outcomes of cryosurgery in keloids and hypertrophic scars. A prospective consecutive trial of case series. Arch Dermatol 1993;129:1146-51 (LEVEL B).
2. Ernst K, Hundeiker M. Results of cryosurgery in 394 patients with hypertrophic scars and keloids. Hautarzt 1995;46:462-6 (LEVEL B).
3. Rusciani L, Rossi G, Bono R. Use of cryotherapy in the treatment of keloids. J Dermatol Surg Oncol 1993;19:529-34 (LEVEL B).
4. Zouboulis CC, Orfanos CE. Cryosurgical treatment of hypertrophic scars and keloids. Hautarzt 1990;41:683-8 (LEVEL B).
5. Sharma S, Bhanot A, Kaur A, Dewan SP. Role of liquid nitrogen alone compared with combination of liquid nitrogen and intralesional triamcinolone acetonide in treatment of small keloids. J Cosmet Dermatol 2007;6:258-61 (LEVEL B.)
6. Har-Shai Y, Dujovny E, Rohde E, Zouboulis CC. Effect of skin surface temperature on skin pigmentation during contact and intralesional cryosurgery of keloids. J Eur Acad Dermatol Venereol 2007;21:191-8 (LEVEL B).
7. Har-Shai Y, Brown W, Labbé D, Dompmartin A, Goldine I, Gil T, *et al*. Intralesional cryosurgery for the treatment of hypertrophic scars and keloids following aesthetic surgery: The results of a prospective observational study. Int J Low Extrem Wounds 2008;7:169-75 (LEVEL B).
8. Har-Shai Y, Amar M, Sabo E. Intralesional cryotherapy for enhancing the involution of hypertrophic scars and keloids. Plast Reconstr Surg 2003;111:1841-52 (LEVEL B).
9. Gupta S, Kumar B. Intralesional cryosurgery using lumbar puncture and/or hypodermic needles for large, bulky, recalcitrant keloids. Int J Dermatol 2001;40:349-53 (LEVEL B).

14. Other therapies: Various growth factors and cytokines, such as basic fibroblast growth factor, transforming growth factor-β, and interleukin-10, extracellular matrix modulators such as prolyl 4-hydroxylase inhibitors and tissue transglutaminase inhibitors, and intralesional injection of botulinum toxin, collagenase,

hyaluronic acid, have been suggested as potential therapeutic options; however, enough evidence is not available for the taskforce to recommend their use in the treatment of keloids.

CONCLUSIONS

The evidence available for many therapeutic modalities for keloids is poor and high quality randomized studies are not available. This may be due to difficulty in blinding, lack of interest of funding agencies and pharmaceutical industry in supporting research on keloids.

Good evidence of efficacy in keloids is available for intralesional steroids, 5-FU, bleomycin, cryosurgery, and surgical excision combined with radiotherapy. The evidence for efficacy of onion extract, imiquimod, interferons, pressure therapy, and silicone products is weak. Surgical excision and carbon dioxide laser should never be used alone in the management of keloids. Overall, there is enough evidence that several therapies have a synergistic effect when used together. In spite of several limitations, significant improvement is achievable with the available treatments.

The final decision to choose a particular therapy depends on the size and site of lesion, age of the patient, reported recurrence rate, esthetic outcome, treating physician's experience with a particular treatment modality, availability, and above all, an informed patient's preference. All the available therapeutic options should be discussed with the patient and they should be allowed to take a decision.

In spite of the availability of a large number of treatment modalities, keloid remains a difficult condition to treat. High recurrence rates, painful treatments, cosmetically unacceptable adverse effects remain a problem in the management of keloids.